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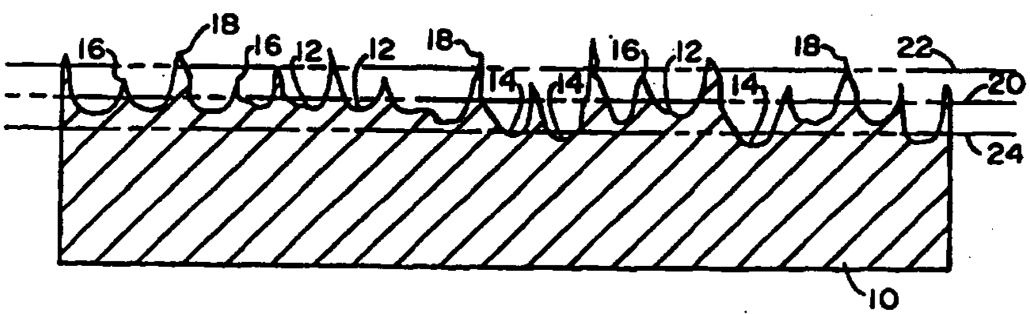
(54) Title: TEXTURE ROLLED LITHOSHEET



(57) Abstract

The method for producing lithosheet by providing at least one roll of a pair of rolls with a surface texture of microscopic size peaks of roll material and a pattern having substantially no directionality such that the roll surface is substantially uniformly rough. A metal sheet (10) is directed between the rolls such that the rolls contact the sheet surfaces to provide at least one surface of the sheet with the non-directional roughness of the textured roll surface and extends the surface area of the sheet by forming microscopic depressions (12, 14) in the sheet surface for holding printing inks, for adhesion of hydrophobic coatings, and/or for providing a non-directional roughness for subsequent graining.

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TEXTURE ROLLED LITHOSHEET

The present invention relates generally to a method of making aluminum substrates for lithographic plates, which is more commonly identified as lithosheet, and more particularly, to using a textured roll to roll aluminum sheet in a manner that transfers the texture of the roll to the sheet thereby eliminating the directional pattern on work rolls, which is present with the current state of the art. The texture transferred to the sheet is of a non-directional, uniform appearance and provides increased surface area to hold suitable amounts of printing ink and/or to provide an improved surface for subsequent graining.

Lithography is defined as the process of printing from a plane surface such as a metal plate on which an image to be printed is ink-receptive and blank areas are ink-repellent. The metal plate used in this process is referred to as "lithoplate". For the purposes of this invention, the term "lithosheet" will refer in particular to aluminum sheet used to make lithoplates. While "lithoplate" incorporates the word "plate", the substrate used to make lithoplate is better described as sheet or foil.

To make the image area, the lithosheet is coated with a hydrophobic (water repelling) light-sensitive material. In general, this material is resistant to attack or dissolution from acids until it is exposed to light and is commonly called a resist.

An extended run of the lithosheet is coated and then cut into a lithoplate. The lithoplate is next overlaid with a negative of a desired image and exposed to light. In the non-image area, the light causes a reaction in the resist which makes it soluble in acid. Thus after exposure the plate is washed with acid to remove the resist leaving the water retentive metal surface of the lithoplate in the non-image areas. The ink-receptive and ink-repellent areas on the lithoplate are developed in the printing process by subjecting the plate to contact with water. The inks used in the printing process are such that they will not stick or adhere to wet surfaces and, thus when the lithoplate is contacted with an ink-laden roller, ink is transferred only to the image area.

It is evident that the quality or suitability of a lithoplate for printing is directly related to the hydrophobic and hydrophilic characteristics of the image. It is known that uniform roughening of the surface by a "graining" process is advantageous to both adherence of the hydrophobic coating to the lithosheet and in enhancing the water retention character of the metal surface. The objective of graining is to increase the surface area and obtain a uniform non-directional roughness necessary for quality production of printed images. The quality and extension of the grained surface can be measured by measuring roughness (height of surface projections above a datum plane of the sheet) and peak count (the number of projections above the datum plane), as discussed below.

Originally, graining lithosheet was accomplished mechanically by ball graining or brushing. In ball graining, a slurry of steel balls and abrasive material is agitated on the sheet with the extent of roughening controlled. In brush graining, brushes are rotated or oscillated over the surface covered with an abrasive slurry. These mechanical graining techniques

require cleaning the sheet by immersion in caustic solution before further processing of the sheet. The uniformity and quality of the roughened surface is difficult to control with these methods and mechanical graining is generally slow and costly.

Because of difficulties in mechanical graining, the constant growth of lithographic printing, higher operating speeds of modern printing presses, the need for longer lithoplate life, etc., increasing attention has been given to electrochemical methods of graining. By these methods, the graining is accomplished by controlled etching of the surface with the use of chemicals or the combination of passing current through a chemical solution and the lithosheet. U.S. Patents 4,301,229, 4,377,447, and 4,600,482 are cited as examples of many patents directed to electrochemically grained lithoplate. To achieve a uniform non-directional roughness with this method requires extended etching of the surface and detailed control of the metal structure. This method also tends to be slow and costly and may result in hazardous chemical waste.

Whether mechanically grained or electrochemically grained, the graining process requires added cost to the fabrication of lithoplates. If lithosheet were produced with a non-direction, extended rough surface meeting roughness and peak count requirements, the necessity of graining would be eliminated. In addition, both the electrochemical and mechanical graining with slurries have certain environmental consequences. What is therefore needed is the production of lithosheet having the necessary extended surface area or produced with a surface which will greatly enhance subsequent graining operations to reduce cost and improve quality.

The present invention provides the above need by texturing a steel roll or rolls in such a manner

that when the roll or rolls are employed to either lightly reduce the thickness of the lithosheet in the last stand of a rolling mill or are used as pinch rolls or skin pass rolls in some other process such as leveling, they impart a surface to the lithosheet with the required roughness, non-directional appearance and peak count. The roll surface is preferably provided with the appropriate texture by electron discharge texturing (EDT). EDT texturing employs a plurality of arc generating electrodes spaced from the roll surface. The arcs provide a generally uniform roll surface of peaks and valleys of appropriate dimensions. The dimensions are controlled by settings on the machine such as the voltage and current of the arcs and pulse length and pulse delay limes between arcs, rotational speed and traverse rates, etc., of the electrodes of the EDT machine relative to the roll surface. Electron discharge texturing is disclosed in such patents as U.S. 3,619,881 and 4,789,447 to Bills et al and Ahmed et al, respectively.

Other texturing methods may be employed to achieve the required roughness, peak count and non-directional appearance on the roll surface. Examples of these other methods may be as well known as sand blasting the rolls, or as sophisticated as laser beam texturing and focused electron beam texturing, as disclosed in U.S. Patent 5,025,547 to Sheu et al.

In the present invention, after the grind marks are removed from the roll surface and the appropriate roughness and peak count is applied by a method of texturing, the textured roll can be used to reduce the thickness of the sheet in the final stand or pass of a rolling mill. This reduction is slight, i.e, in the range of zero to fifteen percent of the thickness such that there is substantially little or no elongation of the texture pattern that is transferred from the roll to the lithosheet surface. This same

transfer can take place from the pressure of textured pinch rolls on the surface of the sheet being passed between them or from the minimal reduction taken in a skin pass mill. Both surfaces of the lithosheet may also be textured to provide a two sided product, but if not, a relatively smooth roll surface is used on the bottom sheet surface to prevent the directional roll grind pattern of the bottom sheet surface from transferring to an upper sheet surface in a tightly wound coil of the lithosheet.

The invention, along with its advantages and objectives, will be better understood from consideration of the following detailed description and the accompanying drawings in which:

Figure 1 is a three-dimensional, computer generated plot of a surface portion of an aluminum alloy sheet showing minimal extended surface area and directional grind lines on the surface of the sheet;

Figure 2 is a three-dimensional, computer generated plot of a portion of an aluminum alloy sheet surface that has been electrochemically grained to increase surface area and reduce directional grind lines;

Figure 3 is a three-dimensional, computer generated plot of a portion of an aluminum alloy sheet surface rolled by an EDT textured roll, the plot showing pockets formed in the sheet surface by the roll surface; and

Figure 4 is a diagrammatic partial sectional view of an aluminum alloy sheet provided with a surface suitable for lithoplate purposes, the surface being exaggerated to show peaks of surface material.

Referring now to the drawings, Figure 1 is a three-dimensional plot of a portion of the surface of an as-rolled aluminum alloy lithosheet, the surface having generally parallel lines formed thereon by a work roll in the final stand or pass of a rolling mill.

(The surface views of Figures 1 to 3 were obtained by a Phase Shift interferometer viewing the surface of a 1050-H18 aluminum lithographic sheet. This instrument uses white light interference fringes [shifts in light phases] to measure relative peak heights of surface material at a magnification of ten times.) Work rolls are ground to a certain finish before being installed and used in a mill. This process involves a stone wheel rotated against the surface of the mill roll that is also rotated. The process leaves elongated fine scratches in the roll surface. These marks are transferred to the sheet surface physically contacting the roll surface, the grind marks appearing as parallel lines on the sheet surface extending in the rolling direction.

The buyer of the lithosheet product of Figure 1 grains the surface of the product, as explained above, to obtain increased surface area, a non-directional appearance and required roughness and peak count. The electrochemically grained surface effected by the buyer is depicted in Figure 2 of the drawings. As shown, the grained surface still has a somewhat directional pattern.

Figure 3 of the drawings shows a lithosheet product rolled using a roll textured by the EDT process, the roll surface having substantially no directional pattern for transferal to a sheet surface. Figure 3 shows, in addition, a generally isotropic pattern of pockets of the extended surface provided by the textured roll for holding water or hydrophobic coating material, the pockets having an average depth of 13 to 17 microinches Ra (arithmetic mean of the pocket depths). The depths of the sheet pockets are provided with a roll surface roughness of 22 to 30 microinches Ra. The roll texture does not transfer perfectly to the sheet surface, as there is usually some elongation of the sheet surface in the rolling

process.

In Figure 4 of the drawings, pockets of different depths are diagrammatically shown in a sectional view of an aluminum alloy sheet 10, and are labeled 12 and 14. The pockets are surrounded by peaks of surface material of different heights, labeled by numerals 16 and 18. The peaks and pockets provide an extended surface for receiving a photosensitive hydrophobic coating and water to repel printing inks. The average surface elevation in Figure 4 is shown as phantom line 20. There is also shown two other phantom lines, labeled 22 and 24, which define equal distances above and below the average elevation 20. The distance between lines 22 and 24 is known as the "bandwidth" and therefore for a defined bandwidth of twenty micro-inches, line 22 is 10 microinches above line 20, and line 24 is 10 microinches below line 20. "Peak-count" is defined as the number of times the surface extends above line 22 and the number of times it extends below line 24. In Figure 4, both the pockets labeled 14 and the peaks labeled 18 are counted in the peak-count number while the pockets labeled 12 and the peaks labeled 16 are not counted in the peak-count number. Preferably, the peak-count for the finite area of the printing surface of sheet 10 lies in the range of 300 to 450 peaks per linear inch measured with a total bandwidth of twenty microinches. Such a peak count for the lithosheet product of the invention is provided by a textured roll having a peak count in the range of 350 to 500 peaks per linear inch extending above and below a total bandwidth of twenty microinches.

While in practice the peak-count perpendicular to the direction in which sheet 10 is rolled is slightly higher than the peak-count parallel to the rolling direction, this same peak-count range is applicable when measured in both directions and results in the non-directional performance of the lithosheet.

Such surface heights and depths, along with peak-counts and roughness in both directions, provide the isotropic surface needed for quality printing.

For reasons described above, it is required that the directional roll grind pattern (Figure 1) be significantly reduced in a graining process so that a non-directional relatively rough surface be available for the lithographic printing processes. By using a textured surface suitable for subsequent graining, a multigrained lithosheet product can be produced. The product of the invention can also be used with no graining at all, and will resemble a grained plate product. This allows the lithoplate producer to eliminate an operation and its associated cost.

CLAIMS

1. A method of producing lithosheet comprising:

providing at least one roll of a pair of rolls with a surface texture of microscopic size peaks of roll material and a pattern having substantially no directionality such that the roll surface is substantially uniform in roughness, and

directing a metal sheet between said pair of rolls such that the rolls contact the sheet surfaces and provide at least one surface of the sheet with the non-directional roughness of the textured roll surface and extends the surface area of the sheet by forming a substantial plurality of microscopic depressions in the surface of the sheet for holding printing inks, for adhesion of the hydrophobic coatings, and/or for providing a non-directional roughness for subsequent graining.

2. The method of claim 1, in which the roll surface has a roughness in the range of 22 to 30 microinches Ra. and provides the lithosheet surface with a roughness in the range of 13 to 17 microinches Ra.

3. The method of claim 1, in which the roll surface has a peak-count of 350 to 500 peaks per linear inch which extend above and below a total bandwidth of twenty microinches and which provides the lithosheet surface with a peak-count in the range of 300 to 450 peaks per inch which extend above and below a total bandwidth of twenty microinches.

4. The method of claim 1, wherein the pair of rolls are located in the last stand of a rolling mill, and

reducing the thickness of the sheet in the range of zero to fifteen percent in said last stand.

5. The method of claim 1, in which the pair of rolls are a set of pinch rolls, and

directing the metal sheet between said rolls

with minimal reduction of sheet thickness.

6. A lithosheet product comprising:

an aluminum alloy sheet provided with a surface of uniform, non-directional roughness and microscopic depressions suitable for holding printing inks, for adhesion of hydrophobic coatings, and/or for providing a non-directional roughness for subsequent graining generated by directing the sheet between a pair of rolls, with at least one of the rolls being provided with a texture of microscopic peaks and having substantially no directional pattern and a uniform roughness, such that the rolls contact the sheet surface and provide at least one surface of the sheet with the non-directional roughness of the roll surface and extends the surface area of the sheet.

7. The product of claim 6, wherein the lithosheet surface has a roughness in the range of 13 to 17 microinches Ra resulting from a textured roll surface having a roughness in the range of 22 to 30 microinches Ra.

8. The product of claim 6, wherein the lithosheet surface has a peak count in the range of 300 to 450 peaks per inch which extend above and below a total bandwidth of twenty microinches resulting from contact with a textured roll surface having a peak-count in the range of 350 to 500 peaks per linear inch which extend above and below a bandwidth of twenty microinches.

9. The product of claim 6, wherein the non-directional roughness and extended area of the aluminum sheet surface a~e provided in the last pass of a rolling mill.

10. The method of claim 9, in which the last pass reduces the thickness of the aluminum alloy sheet in the range of zero to fifteen percent.

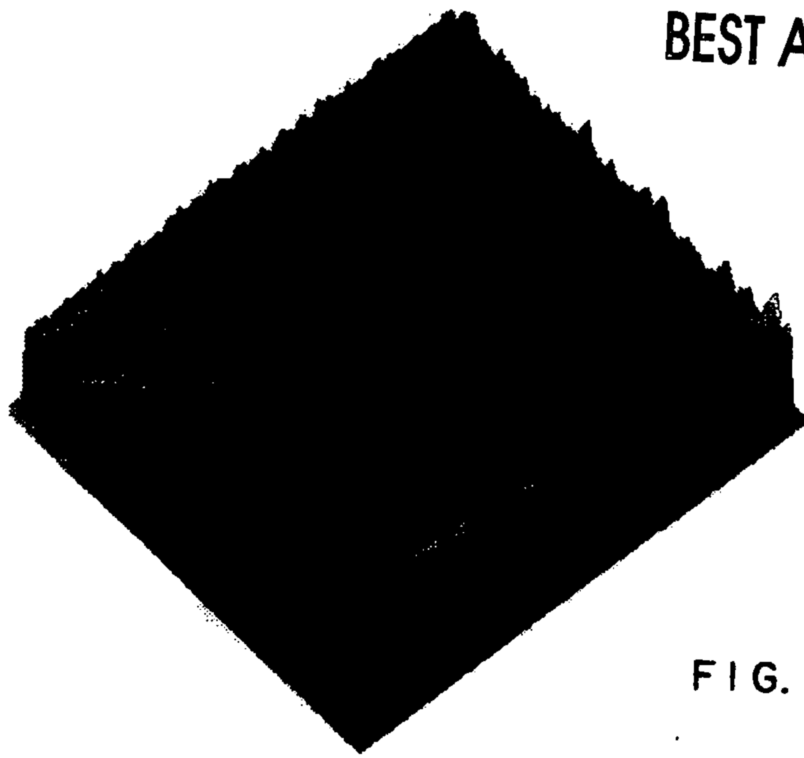
11. The method of claim 1, in which said surface texture of said rolls is provided by electron discharge

texturing.

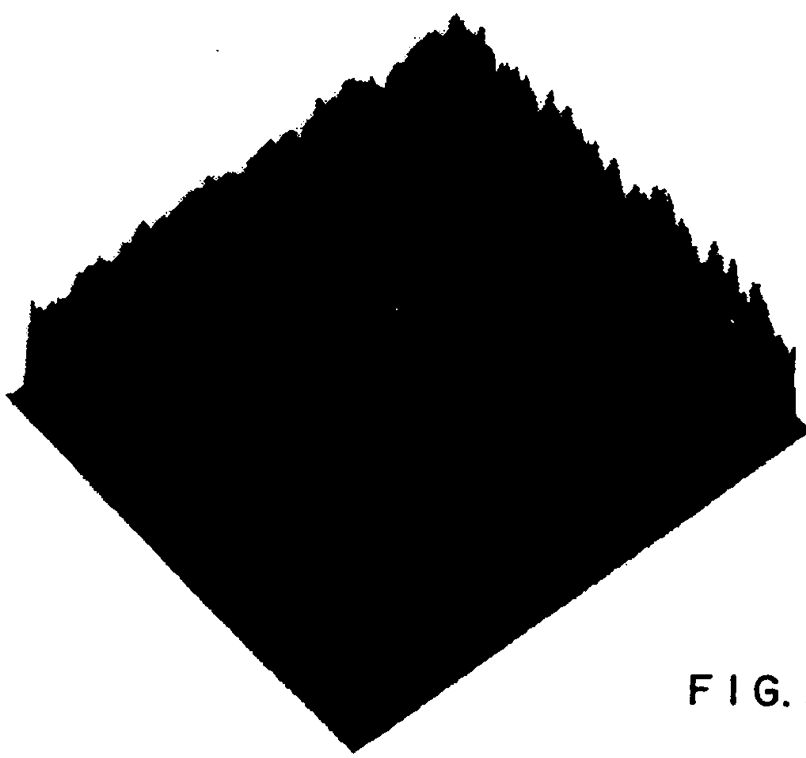
12. The method of claim 1, in which said surface texture of said rolls is provided by sand blasting, laser beam or by focused electron beam.

13. The method of claim 6, in which said surface texture of said rolls is provided by electron discharge texturing.

14. The method of claim 6, in which said surface texture of said rolls is provided by sand blasting, laser beam or by focused electron beam.



F I G. 1



F I G. 2

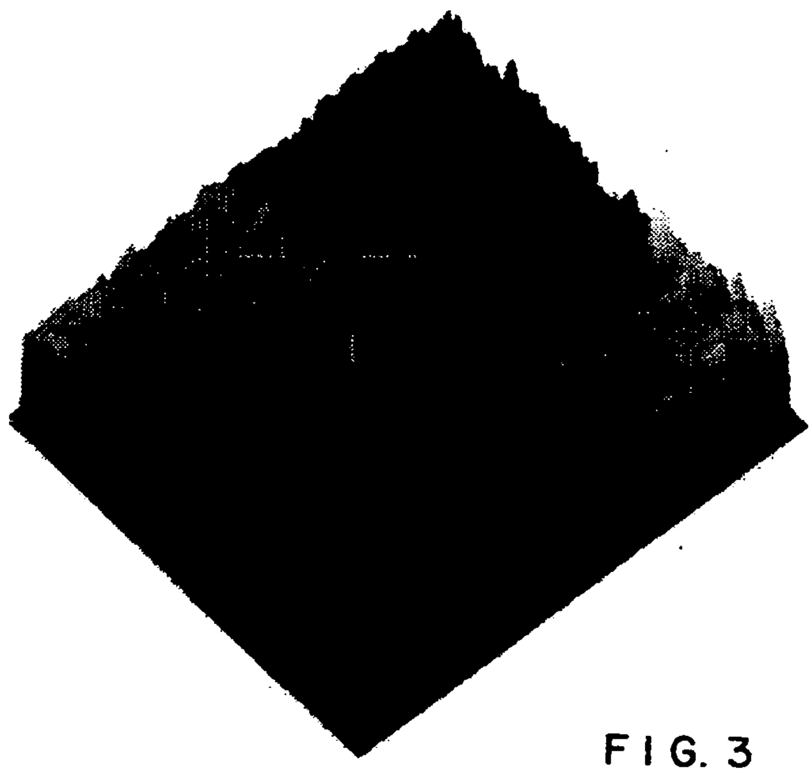


FIG. 3

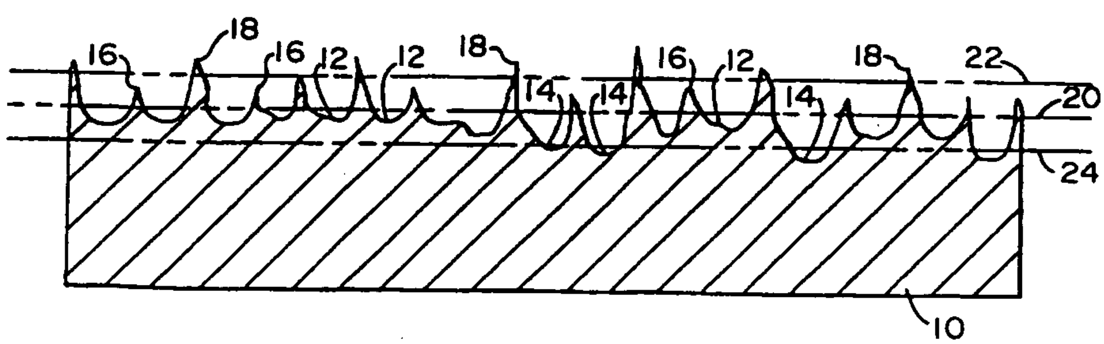


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/03030

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B41N3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B41N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 010, no. 368 (M-543), 9 December 1986 & JP 61 162351 A (KOBE STEEL LTD), 23 July 1986,	1-11,13
Y	see abstract	12,14

Y	PATENT ABSTRACTS OF JAPAN vol. 018, no. 098 (M-1562), 17 February 1994 & JP 05 301479 A (MITSUBISHI KASEI CORP), 16 November 1993, see abstract	1,12,14

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 June 1997	09.07.97

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 481 084 A (PATRICK EDWARD P ET AL) 2 January 1996 see column 2, line 20 - line 26 see column 7, line 16 - line 23 see column 7, line 46 - line 53 see column 13, line 24 - line 31 see column 17, line 59 - column 18, line 47 see column 21, line 46 - line 50 see column 22, line 44 - line 54 -----	1,12,14

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inten nal Application No
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